

CLAIMS

1. A method of compressing a substance by impact using a relativistic vacuum diode having an axisymmetric vacuum chamber with current-conducting walls, an axisymmetric plasma cathode and an axisymmetric anode-enhancer, including:

5 producing a target in the shape of an axisymmetric part made of a condensed substance that functions as at least a part of the anode-enhancer,

placing the anode-enhancer into the relativistic vacuum diode chamber with a gap towards the plasma cathode practically on the same geometric axis therewith, and

10 pulse discharge of a power source via the relativistic vacuum diode in the electron beam self-focussing mode on the surface of the anode-enhancer,

characterized in that

the axisymmetric plasma cathode is used in the form of a current-conducting rod comprising a dielectric end element having the perimeter of the rear end embracing the perimeter of said rod at least in the plane perpendicular to the axis of symmetry of the cathode as the whole with a continuous gap, and the area of the emitting surface being
15 greater than the maximum cross-section area of the anode-enhancer,

the anode-enhancer is placed with such a gap towards the plasma cathode that the center of curvature of the working surface of the anode enhancer is located inside the focal space of the collectively self-focussing electron beam, and

20 the anode-enhancer is acted upon by an electron beam having the electron energy not smaller than 0.2 MeV, current density not smaller than 10^6 A/cm² and duration not greater than 100 ns.

2. The method of claim 1 **characterized** in that used in the relativistic vacuum diode plasma cathode has a pointed current-conducting rod, the dielectric end element
25 of this cathode is provided with an opening for setting on said rod, and the setting part of said rod together with the pointed end is located inside the opening.

3. The method of claim 1 **characterized** in that the target is formed in the shape of an insert into the central part of the RVD anode-enhancer, the diameter of said insert is chosen in the range of 0.05 to 0.2 of the maximum cross-sectional dimension (d_{max})
30 of the anode-enhancer.

4. The method of claim 1 **characterized** in that at least that part of the anode-enhancer, which is directed to the plasma cathode, is spheroidally formed prior to mounting in the relativistic vacuum diode.

5. The method of claim 3 **characterized** in that the target is formed in the shape
35 of a spheroidal body tightly fixed inside the anode-enhancer in such a way that the centers of the inner and outer spheroids practically coincide.

6. The method of claim 1 **characterized** in that the anode-enhancer is acted upon by an electron beam having the electron energy up to 1.5 MeV, current density not

greater than 10^8 A/cm² and duration not greater than 50 ns.

7. The method of claim 6 **characterized** in that the current density of the electron beam is not greater than 10^7 A/cm².

8. The method of claim 1 **characterized** in that the residual pressure in the vacuum chamber of the relativistic vacuum diode is maintained at the level not greater than 0.1 Pa.

9. A device for impact compression of a substance, which is based on relativistic vacuum diode and is comprised of:

a strong gas-tight housing a part of which is made of a current-conducting material shaped in axial symmetry to confine a vacuum chamber, and

an axisymmetric plasma cathode and an axisymmetric anode-enhancer mounted with a gap in the vacuum chamber practically on the same geometric axis of which at least the cathode is connected to a pulse high-voltage power source

characterized in that

the plasma cathode is made in the form of a current-conducting rod comprising a dielectric end element having the perimeter of the rear end embracing the perimeter of said rod at least in the plane perpendicular to the axis of symmetry of the cathode with a continuous gap, and the area of the emitting surface being greater than the maximum cross-section area of the anode-enhancer,

at least one of the relativistic vacuum diode electrodes is provided with means for adjusting the gap between the electrodes, and

the distance from the common geometric axis of said plasma cathode and anode-enhancer to the inner side of the current-conducting wall of the vacuum chamber is greater than $50d_{max}$, where d_{max} is a maximum cross-sectional dimension of the anode-enhancer.

10. The device of claim 9 **characterized** in that the current-conducting rod of the plasma cathode is pointed and the dielectric end element is provided with an opening for setting on said rod the setting part of which is located inside said opening together with the pointed end.

11. The device of claim 9 **characterized** in that the anode-enhancer has a circular shape in the cross section and is completely produced of a material to be transmuted that is current-conducting in its main mass.

12. The device of claim 9 **characterized** in that the anode-enhancer is made composite and comprises at least a one-layer solid shell and an inserted target tightly embraced by this shell, said target being in the shape of a body of revolution and made of an arbitrary condensed material with a diameter within the range of $(0.05-0.2) \cdot d_{max}$, where d_{max} is a maximum cross-sectional dimension of the anode-enhancer.

13. The device of claim 9 **characterized** in that at least one shield preferably of current-conducting material is mounted in the tail part of the anode-enhancer.

14. The device of claim 13 **characterized** in that said shield is a thin-wall body of revolution with the diameter not less than $5d_{max}$ which is spaced from the nearest to the plasma cathode end of said anode-enhancer by the distance up to $20d_{max}$, where d_{max} is a maximum cross-sectional dimension of the anode-enhancer.

15. The device of claim 14 **characterized** in that said thin-wall body of revolution has a flat or concave surface at the side of the anode-enhancer.

16. An axisymmetric plasma cathode for the relativistic vacuum diode having a current-conductive rod for connection to a pulsed high-voltage power source and a dielectric end element **characterized** in that the perimeter of the rear end of the dielectric element embraces the perimeter of said rod with a continuous gap at least in the plane perpendicular to the axis of symmetry of the cathode.

17. The cathode of claim 16 **characterized** in that the current-conducting rod thereof is pointed and the dielectric end element is provided with an opening for setting on said rod the setting part of which is located together with the pointed end inside the said opening.

18. The cathode of claim 17 **characterized** in that the dielectric end element has a blind opening.

19. The cathode of claim 17 **characterized** in that the dielectric end element has a through opening.

20. The cathode of claim 16 **characterized** in that the dielectric end element is made of a material selected from the group consisting of carbon-chain polymers with single carbon-to-carbon bonds, paper-base laminate or textolite type composite materials with organic binders, ebony wood, natural or synthetic mica, pure oxides of metals belonging to III-VII groups of the periodic table, inorganic glass, sitall, basalt-fibre felt and ceramic dielectrics.

21. The cathode of claim 16, 17 or 18 **characterized** in that the dielectric end element has a developed surface.

22. The cathode of claim 16 or 17 **characterized** in that the minimum cross-sectional dimension of said dielectric element is $c_{de\ min} = (5-10) \cdot c_{cr\ max}$, and the length of said element is $l_{de} = (10-20) \cdot c_{cr\ max}$, where $c_{cr\ max}$ is a maximum cross-sectional dimension of the current-conducting rod.